(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 0 862 320 A2

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
02.09.1998 Bulletin 1998/36

(51) Int. Cl.[6]: H04N 1/407

(21) Application number: 98108508.7

(22) Date of filing: 01.07.1994

(84) Designated Contracting States:
DE FR GB

(30) Priority: 01.07.1993 US 83583

(62) Document number(s) of the earlier application(s) in accordance with Art. 76 EPC:
94304828.0 / 0 632 644

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Remarks:
This application was filed on 11 - 05 - 1998 as a divisional application to the application mentioned under INID code 62.

(54) An apparatus and method for correcting offset and gain drift present during communication of data

(57) The present invention is directed to a system and method for compensating for offset and gain drift in a fast scan direction during an image forming process. To achieve compensation, the present invention samples a plurality of permanently darkened pixels upon powering up image sensors and circuitry therefor and during a sub-scanning process of an image and feeds this information into an offset value generating circuit. The offset generating circuit continually adjusts a pixel offset voltage according to a difference between sequential samples of the permanently darkened pixel, thereby compensating for fast scan offset drift. The present invention also samples a plurality of active pixels during a scanning of a calibration strip. From this scan, a gain corrective value is calculated. The present invention then samples active pixels during a scanning of a platen background. In response to this sampling, the gain corrective value is continually adjusted according to a difference between sequential samples of the platen background, thereby compensating for fast scan gain drift. The present invention can also compensate and balance transfer functions for a plurality of communication channels in a multi-channel system by using the same target values and same reference signals for each channel.

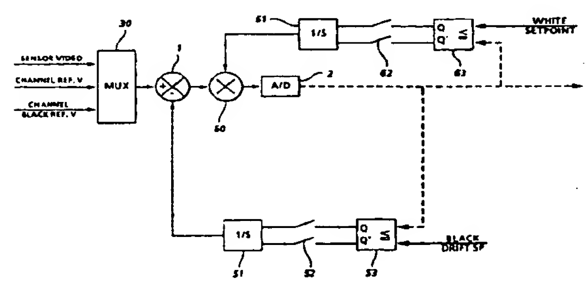

FIG.1

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Description

The present invention, generally, is directed to a device for compensating offset and gain drift present in the communication of electronic data, and particularly, in the communication of image data in an image processing apparatus.

A problem prevalent in the communication of electronic data, especially, image or video data, is offset drift and gain drift. Offset and gain drift can be caused by the characteristics of individual components responsible for processing or communicating the image data; i.e., a shift register functioning as a buffer for the signals received from a charged coupled device (CCD) may have inherent offset and gain characteristics unique to itself or a scanner may contribute to offset and gain drift due to the present operating conditions; i.e., the operating temperature, light temperature, age, etc. Moreover, offset and gain drift may be attributed to the individual characteristics of the channel transporting the data from one component to another during the processing cycle. If offset drift or gain drift is not adequately addressed; i.e., the signal being processed is not adjusted to counteract the offset or gain drift; the processing of the signal will not be accurate which, in an image processing system, can cause the generated picture or image to have a lower quality.

In systems employing image viewing devices, such as charge coupled devices (CCDs), for viewing by raster scanning an original, the output signal produced by the CCD includes a potential attributable to the inherent operating characteristics of the CCD. To restore the image output signal of the CCD to a true or absolute value, the potential derived from the CCD, referred to as the offset potential or signal, must be removed from the image signal. However, if the offset signal that is removed is greater or less than the actual offset signal, a noticeable aberration or distortion in the image output signal may result. Since the operating characteristics of a CCD often vary widely from one CCD to another and even vary from time to time for the same CCD or for different integration rates, the accurate determination of the offset signal to be removed is often difficult. The problem is further complicated in systems where multiple CCDs are employed.

Operating systems utilizing the afore-mentioned image viewing devices are designed for a fixed image signal gain. However, since the operating characteristics of an individual CCD in an imaging device may vary, the signal gain may vary from one CCD to another, or may even vary for the same CCD. Thus, where a system is optimized for a specific CCD operating at a specific speed, one would have to redesign or recalibrate the system to accommodate a change in gain due to changes in the operating characteristics of the CCD or if the CCD is replaced with another one.

To address these problems, typical image processing systems or image scanning systems perform calibrations of the image sensor once every predetermined number of scans. In most cases, the predetermined number of scans is less than ten, but, many systems calibrate the image sensor prior to each scan. Even though these systems have addressed the problem of offset and gain drift, the compensation techniques used in these systems do not fully compensate for integral changes in offset or gain characteristics and are not readily adaptable to systems which must process data at a high speed, for example, a constant velocity transport image processing apparatus.

Another problem associated with the correction of offset and gain drift is the establishment of reference values through calibration. In a typical platen scan configuration, calibration is not a substantial problem since the carriage can scan the calibration target before the scanning of each individual document. However, in a constant velocity transport system, the carriage is stationary, and thus, it is practically impossible to scan a calibration target before each individual scanning of a document. Therefore, with respect to a constant velocity transport system, it is necessary to have a calibration system wherein an unlimited number of scans can be made between actual generation of calibration values and still adequately compensate for offset and gain drift due to the prevailing operating conditions.

To realize this goal, the factors that cause the system to have to be recalibrated have to be corrected. These factors are typically profile drifts due to thermal changes in the sensor bar, video circuits, or the illumination system. The drifts can be in the form of offset changes or gain changes and can occur in the fast scan direction or the slow scan direction. It is noted that there are many methods which address the slow scan drift correction.

However, these various methods are not able to correct changes in the form of offset and gain that occur in the fast scan direction, nor are these methods effective in a constant velocity transport system. Moreover, with the recent development of full width array systems, the effective gain drift changes in the fast scan direction become more prevalent, notwithstanding the system being used; i.e., platen scan or constant velocity transport. This is due to the fact that the full width arrays are made of several smaller arrays joined together in a butted or staggered manner.

Fast scan offset drift is caused by temperature changes and differences between the individual sensor chips or video channels. On the other hand, fast scan gain changes are caused by either changes in the profile of the lamp changing due to thermal operating characteristics of the lamp or by gain drift in the actual sensor chip or the video channels.

Another component of an image processing system which experiences problems with gain and offset drift is the actual channels utilized to transfer or communicate the image data between points within the image processing system. More specifically, in analog video

systems, where there are multiple channels of image or video data, it is important that each channel has the same transfer function or response characteristics. Any differences between the channels can produce differences in the final image, such as channel banding or streaking. Even though each channel might be identical in design, there are various tolerances associated with the components of each channel and hence there will always be a slight difference in the performance for each channel.

The difficulty with the prior art compensation systems is that these systems cannot compensate for offset and gain drift in the fast scan direction or be readily implemented in a high speed copier configuration as illustrated in Figure 1. The compensation system must be able to quickly adjust the offset and gain setting for changes in operating characteristics, and more specifically, to characterise changes realized along a fast scan direction.

It is an object of the present invention, therefore, to provide a method or system that readily responds to offset and gain changes in the fast scan direction and is adaptable to high speed copiers.

Accordingly, the present invention provides a method for correcting a gain characteristic for a communication channel of a video system, including

(a) injecting a channel white reference signal onto a channel;
(b) sampling an output of the channel downstream of a point where the channel white reference signal was injected in said step (a);
(c) calculating a gain value of the channel in accordance with the output sampled in said step (b); and
(d) applying a gain to the channel according to the calculated gain value, thereby correcting a gain characteristic of the channel.

According to a second aspect of the present invention, a method for correcting an offset characteristic for a communication channel of a video system, includes the steps of

(a) injecting a channel black reference signal onto a channel;
(b) sampling an output of the channel downstream of a point where the channel black reference signal was injected in said step (a);
(c) calculating an offset value for the channel in accordance with the output sampled in said step (b); and
(d) applying an offset voltage to the channel according to the calculated offset value, thereby correcting an offset characteristic of the channel.

The present invention will be described further by way of examples with reference to the accompanying drawings in which:-

Figure 1 illustrates an example of a constant velocity transport system;
Figure 2 illustrates an example of a full width array system utilized by the present invention;
Figure 3 shows a block diagram illustrating an embodiment also described in the parent application which compensates for gain drift in the fast scan direction;
Figure 4 shows a block diagram illustrating an embodiment also described in the parent application which compensates for both offset and gain drift;
Figure 5 shows a block diagram illustrating an embodiment of the present invention which compensates for offset drift with respect to a channel's particular characteristics;
Figure 6 shows a block diagram illustrating an embodiment of the present invention which compensates for gain drift with respect to a channel's particular characteristics;
Figure 7 shows a block diagram illustrating an embodiment of the present invention which compensates for both offset and gain drift with respect to a channel's particular characteristics;
Figure 8 illustrates a flow chart method of a method also described in the parent application which compensates for gain drift with respect to a fast scan relationship and
Figure 9 illustrates a flow chart showing a method which balances the transfer functions of a multichannel system, thereby compensating for both offset and gain drift within a particular channel.

The following will be a detailed description of the drawings illustrating the present invention. In this description, as well as in the drawings, like reference numerals represent the devices or circuits or equivalent circuits which perform the same or equivalent functions.

With respect to the present invention, a sensor could be any type of device capable of receiving image data in an optical manner. In the preferred embodiment of the present invention, the sensors are charged coupled devices (CCDs) constructed to form a full width array. This full width array can be constructed by either butting together smaller arrays of charge coupled devices (sensor chips), or staggering smaller arrays of charge coupled devices. In these charge coupled devices, individual active pixels are utilized to sense the received light and produce an electrical signal represented thereof.

An example of a full width array charge coupled device 10 is illustrated in Figure 2. In Figure 2, a plurality of pixels are arranged on individual sensor chips 11. These pixels comprise a set of active pixels 13 which are used to actually convert the received image into electric signals and a small set of adjacent permanently

darkened pixels 12 which may be utilized in the determination of the offset corrective value, as described in our parent application EP-A-0632644.

In an embodiment described in our parent application, each individual sensor chip 11 has associated therewith a plurality of active pixels 13 and a small set of permanently darkened pixels 12. However, it is possible to have a single permanently darkened pixel corresponding to each individual active pixel in lieu of a group of permanently darkened pixels 12 corresponding to a larger set of active pixels 13.

Figure 3 shows a block diagram illustrating another embodiment as described in our parent application which corrects for gain drift in a fast scan direction or for a constant velocity transport system. Figure 3 includes a multiplexer 30, an adder 1, an analog to digital converter 2, a multiplier 3, and a gain corrective value generating circuit 45. This gain corrective value generator circuit 45 has a comparator 41 and a multiplier 40. Upon powering up the circuitry corresponding to the image sensors, a sample of a calibration strip is taken and a pixel-pixel gain corrective value is determined. Also, the platen background is sampled and the value therefrom is saved as a reference value for the fast scan profile. This reference value corresponds to the white drift or gain drift set point inputted into the comparator 41.

In the present invention, the pixel-pixel gain corrective value can be divided into a multitude of segments wherein one segment can correspond to one sensor chip. However, the segmentation can be greater; i.e., more than one segment per chip; or less; i.e., more than a chip per segment. It is noted that the selection of the segmentation can affect image quality. However, the gain reference values for each segment are averaged to produce a single value reference. It is noted that white reference signals from each chip could be isolated such that a gain reference value can be saved for each chip so that the gain corrective value can be individualized for each chip.

Between individual scans of a document, when the carriage is in a parked position (the position is illustrated in Figure 1 with reference to a constant velocity transport system wherein the scanner 23 can sample the platen background 22 that is located between individual documents 21), the platen background 22 is sampled again to generate a white reference signal as sensor video data which the multiplexer 30 selects to be inputted into the adder 1. This white reference signal is inputted into the comparator 41 to be compared with the gain or white drift set point. The comparator 41 compares the white reference signal with the gain or white drift set point to determine if there has been a change in the gain characteristics of the sensor chip or full width array system.

If there is a difference between the white drift set point and the white reference signal, the comparator generates an adjustment signal or value corresponding to this difference. If the gain compensation methodology calls for segmentation, the adjustment signal is broken down according to a weighting scheme, and individual adjustment signals are used to make individual adjustments to the segmented pixel-pixel gain corrective value. The weighting scheme, for example could be a factor of.1 for each segment if there are ten segments, or could be factors of .1, .2, 0, .1, .5, 1.5, .75, 1.25, 0, and 2 if there are ten segments. The actual weighting scheme can be implemented to correspond to the unique characteristics of the scanner.

These adjustment signals are fed to a multiplier 40 which multiplies the adjustment signals with the pixel-pixel gain corrective values to produce adjusted gain corrective values. The multiplier 40 outputs the adjusted gain corrective values to a multiplier 3 which multiples the actual image data to compensate for gain drift in the segments. Again, this adjustment can be individualized to each sensor chip without relying on a predetermined weighting scheme.

In the above embodiment, gain is determined in a conventional manner. More specifically, a reference signal representing a full light value is fed into the system; for example, 5 volts. After correction for offset, if offset is to be corrected, the remaining value of the signal outputted from the system is compared with 5 volts. If the outputted signal, for example, is 8 volts, the gain corrective value is determined to be .625 and used in subsequent scans so that all outputted full light values are 5 volts. On the other hand, if the outputted signal, for example, is 4 volts, the gain corrective value is determined to be 1.25 and used in subsequent scans. It is noted that any reference value other than 5 volts may be used.

Figure 4 shows a block diagram illustrating a further embodiment described in our parent application which compensates for offset and gain drift in either a fast scan direction or for a constant velocity transport system, as illustrated in Figure 1.

In Figure 4, a video or image signal from a sensor is inputted into a multiplexer 30. Moreover, the multiplexer 30 receives black reference signals as part of the sensor video data at predetermined locations within the data stream. These black reference signals are produced from the sampling of permanently darkened pixels 12, as illustrated in Figure 2. The black reference signal is a signal which represents the situation where a sensor would receive no light. The image signals produced by the active pixels 13 are inputted to the multiplexer 30 as sensor video data. The black reference signals are produced by the permanently darkened pixels 12.

The multiplexer 30 is connected to an adder 1 which adds in a previously determined offset correction value to the sensor video data. During initial calibration, this value is zero so that an initial offset can be determined from the permanently darkened pixels 12. After adding in the offset correction value, the adder 1 outputs a signal to an analog to digital converter 2. The

analog to digital converter 2 converts the analog data, which has been corrected for offset, into a digital signal and inputs the digital signal into a multiplier 3. Multiplier 3 multiplies the digital signal received from the analog to digital converter 2 with a gain corrective value which will be discussed in more detail below.

To determine the offset correction value, Figure 4 utilizes a circuit comprising a comparator 33, an adder 32, and a digital to analog converting circuit 31. These three circuits make up the offset corrective value generating circuit 35.

To correct for gain drift in a fast scan direction or for a constant velocity transport system, Figure 4 includes a gain corrective value generating circuit 45. This gain corrective value generator circuit 45 has a comparator 41 and a multiplier 40 and functions the same as the gain corrective value generator circuit described above with respect to Figure 3. It is noted that Figure 4 illustrates a system in which the offset is corrected prior to the gain calculation and correction. This is to insure an accurate calibration of the gain characteristics.

Figure 5 shows a block diagram illustrating an embodiment of the present invention which corrects for offset drift in a communication channel. Figure 5 includes a multiplexer 30, an adder 1, an analog to digital converter 2, and a channel offset compensation circuit 55. This channel offset compensation circuit 55 has a variable voltage source 51, a switching circuit 52, and a comparator 53. Initially, a channel black reference signal is injected upon a channel through multiplexer 30. This channel black reference signal is sampled by the comparator 53 and compared with a black signal target value to establish an initial offset value point; i.e., the comparator 53 determines the offset value of the channel with respect to the difference between the channel black reference signal and the black signal target value.

Upon determining the offset value, comparator circuit 53 outputs a signal corresponding to the offset value. The signal is fed through a switching circuit 52 and applied to the variable voltage source 51. The variable voltage source 51 generates an offset voltage in response to the signal received from the switching circuit 52. This offset voltage is then applied to the sampled channel through adder 1 to compensate for offset drift within that channel.

During operations of the device, the comparator 53 samples subsequent transmissions of a channel black reference signal which are sent along a channel to determine whether the offset characteristics of the channel have changed due to operating conditions. The comparator 53 compares the subsequently sampled channel black reference signals with the same target value (black signal set point) to determined if there is a difference between the subsequently sampled channel black reference signal and the same target value. If there is a difference between the signals, the comparator 53 generates a new signal corresponding to the difference, thereby continually monitoring changes in the offset characteristics. This new signal produced by the comparator 53 is outputted to the variable voltage source 51 through the switching circuit 52. In response to this new signal received from the comparator 53, the variable voltage source 51 generates a new offset voltage to be applied to the channel through adder 1 to compensate for any change in offset characteristics of the channel.

Figure 6 shows a block diagram illustrating an embodiment of the present invention which corrects for gain drift in a communication channel. Figure 6 includes a multiplexer 30, a multiplier 60, an analog to digital converter 2, and a channel gain compensation circuit 65.

The channel gain compensation circuit 65 has a variable signal generator 61, a switching circuit 62, and a comparator 63. Initially, a channel white reference signal is injected upon a channel through multiplexer 30. This channel white reference signal is sampled by the comparator 63 and compared with a white signal target value to establish an initial gain value point; i.e., the comparator 63 determines the gain value of the channel with respect to the difference between the white reference signal and the white signal target value.

Upon determining the gain value, comparator circuit 63 outputs a signal corresponding to the gain value. The signal is fed through a switching circuit 62 and applied to the variable signal generator 61. The variable signal generator 61 generates a signal in response to the signal received from the switching circuit 62. This signal is then applied to the multiplier 60 of the sampled channel to compensate for gain drift within that channel.

During operations of the device, the comparator 63 samples subsequent transmission of a channel white reference signal which are sent along a channel to determine whether the gain characteristics of the channel have changed due to operating conditions. The comparator 63 compares the subsequently sampled channel white reference signals with the same target value (white signal set point) to determined if there is a difference between the subsequently sampled channel white reference signal and the same target value. If there is a difference between the signals, the comparator 63 generates a new signal corresponding to the difference, thereby continually monitoring changes in the gain characteristics. This new signal produced by the comparator 63 is outputted to the variable signal generator 61 through the switching circuit 62. In response to this new signal received from the comparator 63, the variable signal generator 61 generates a new signal to be applied to the multiplier 60 of the channel to compensate for any change in gain characteristics of the channel.

Figure 7 shows a block diagram illustrating a twelfth embodiment of the present invention which compensates both offset and gain drift in a communication channel. Figure 7 includes a multiplexer 30, an adder 1, a multiplier 60, an analog to digital converter 2, a channel offset compensation circuit 55, and a channel gain

compensation circuit 65.

The channel offset compensation circuit 55 and the channel gain compensation circuit 65 function the same as described above, to Figures 5 and 6, respectively; therefore, a detailed description thereof will be omitted. It is noted that offset compensation is carried out prior to gain compensation to insure a more accurate gain calculation.

Figure 8 illustrates a method of the present invention as described in our parent application which corrects for gain drift in a fast scan direction or in a constant velocity transport system. This method corrects fast scan gain drift in signals outputted from of active pixels of an image apparatus by performing the following steps.

At step s10, the present invention scans a calibration strip and samples an initial output signal from each active pixel produced as a result of scanning the calibration strip. At step s11, a gain corrective value is calculated from the output sampled in step s10 and stored. At step s12, an output from each active pixel is sampled during an initial scanning of a background. Then at step s13, an average gain value is calculated from the output sampled in step s12 and stored as a reference value. The method again samples an output from each active pixel produced as a result of a scanning of a background between a complete scanning of an image at step s14. From these subsequent samples, a new average gain value is calculated at step s15. At step s16, the present invention determines if there is a difference between the stored reference value and the average gain value calculated in step s15. If step s16 determines a difference, step s17 adjusts the gain corrective value according to the difference determined in step s16. At step s18, either the adjusted corrective gain value or the unadjusted corrective gain value is applied depending upon the determination in step s16. By readjusting the corrective gain value in this way, the present invention can compensate for fast scan gain drift in the signals outputted from the active pixels.

Figure 9 illustrates a method of the present invention which corrects for offset and gain drift in a plurality of communication channels transporting data. The following are the steps of this method.

At step s20, the present invention injects a same channel black reference signal onto each channel of a plurality of channels. At step s21, the present invention samples an output from each channel downstream of a point where the channel black reference signal was injected. The method then calculates a separate offset value for each channel at step s22 by comparing the sampled channel black reference signal with a same target black signal value. The procedure further applies an offset voltage to each channel according to the calculated offset value corresponding to that channel at step s23, thereby correcting an offset characteristic of the channel and balancing the offsets for the plurality of channels.

At step s24, the present invention injects a same channel white reference signal onto each channel of a plurality of channels. At step s25, the present invention samples an output from each channel downstream of a point where the channel white reference signal was injected. The method then calculates a separate gain value for each channel at step s26 by comparing the sampled channel white reference signal with a same target white signal value. The procedure further applies a gain to each channel according to the calculated gain value corresponding to that channel at step s27, thereby correcting a gain characteristic of the channel and balancing the gains for the plurality of channels.

Although the present invention has been described in detail above, various modifications can be implemented without imparting from its spirit. For example, even though the invention has been described in an image processing context, the methods and concepts are readily applicable to other environments. For example, the offset drift and gain drift compensation schemes are equally applicable to systems processing data wherein the components are subject to different operating conditions which would make a standard compensation value less effective. More specifically, offset and gain drifts for a sensor operating near absolute zero, will be different from the offset and gain drifts of a sensor operating at room temperature.

Furthermore, the channel compensation process is equally applicable to any communication path that has its transfer function continually changing in view of operating conditions. More specifically, the channels of communication are not limited to a hardwire in an image processing device, but may be telephone lines, radio frequencies, or other channels of communication susceptible to external conditions or require compensation for individualized transfer functions. In the preferred embodiment, the multi-channel system carries a single image which has been partitioned or split up into small fragments which are communicated in parallel between the sensors and the image processor or other device. However, this multi-channel system can carry a plurality of images wherein a single image is assigned to a single channel when the system requires a uniform transfer function for each channel, thus the type of data being communicated over the channels is not limited to fragmentations of a single image.

Lastly, the white drift set points value for the pixel gain correction circuit of the parent application and the white drift set point value for the channel gain correction circuit of the present invention may be the same values or different values. In the preferred embodiment, the two white drift set point values are different.

Claims

1. A method for correcting a gain characteristic for a communication channel of a video system, including

(a) injecting a channel white reference signal onto a channel;

(b) sampling an output of the channel downstream of a point where the channel white reference signal was injected in said step (a);

(c) calculating a gain value of the channel in accordance with the output sampled in said step (b); and

(d) applying a gain to the channel according to the calculated gain value, thereby correcting a gain characteristic of the channel.

2. A method for correcting an offset characteristic for a communication channel of a video system, including

(a) injecting a channel black reference signal onto a channel;

(b) sampling an output of the channel downstream of a point where the channel black reference signal was injected in said step (a);

(c) calculating an offset value for the channel in accordance with the output sampled in said step (b); and

(d) applying an offset voltage to the channel according to the calculated offset value, thereby correcting an offset characteristic of the channel.

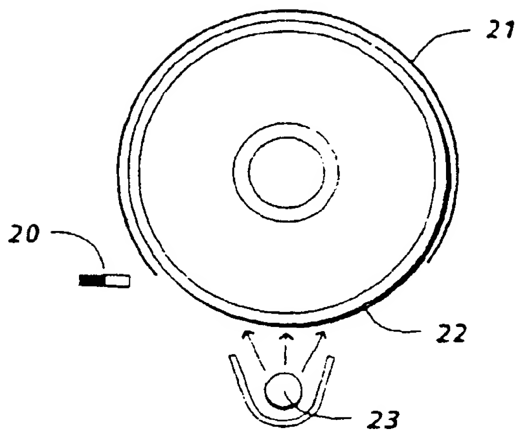


FIG. 1
PRIOR ART

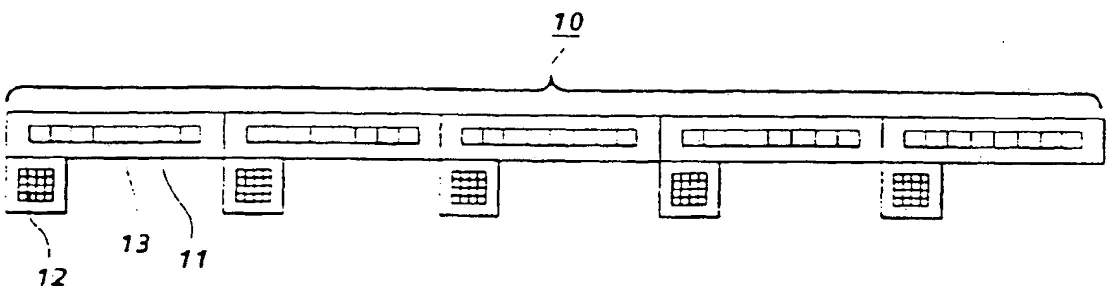


FIG. 2

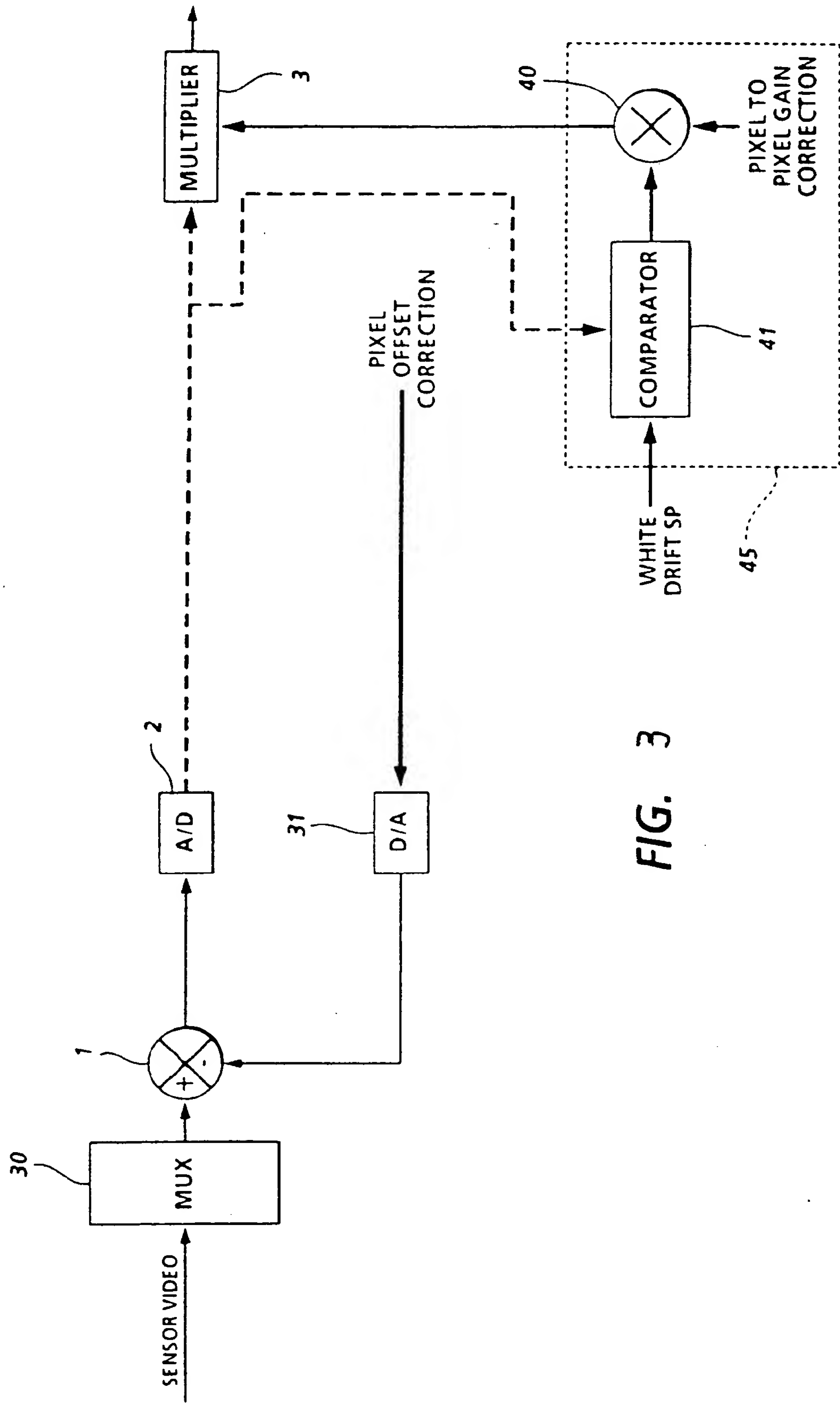
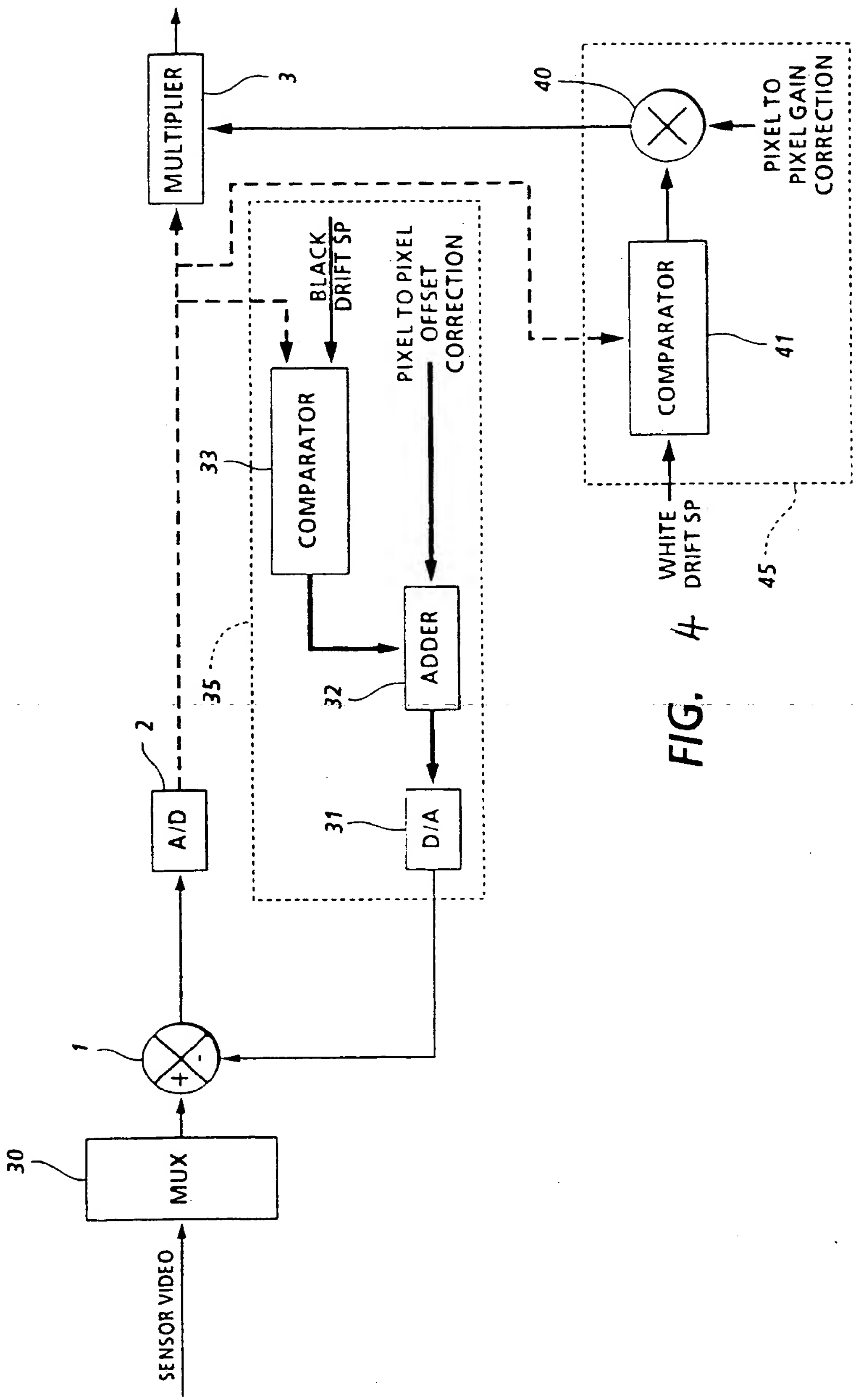

SENSOR VIDEO
MUX
30
1
+
-
A/D
2
D/A
31
PIXEL OFFSET CORRECTION
MULTIPLIER
3
COMPARATOR
41
40
PIXEL TO PIXEL GAIN CORRECTION
WHITE DRIFT SP
45

FIG. 3


SENSOR VIDEO
MUX
30
1
+
-
A/D
2
MULTIPLIER
3
35
COMPARATOR
33
BLACK DRIFT SP
PIXEL TO PIXEL OFFSET CORRECTION
ADDER
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D/A
31
40
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COMPARATOR
41
WHITE DRIFT SP
45

FIG. 4

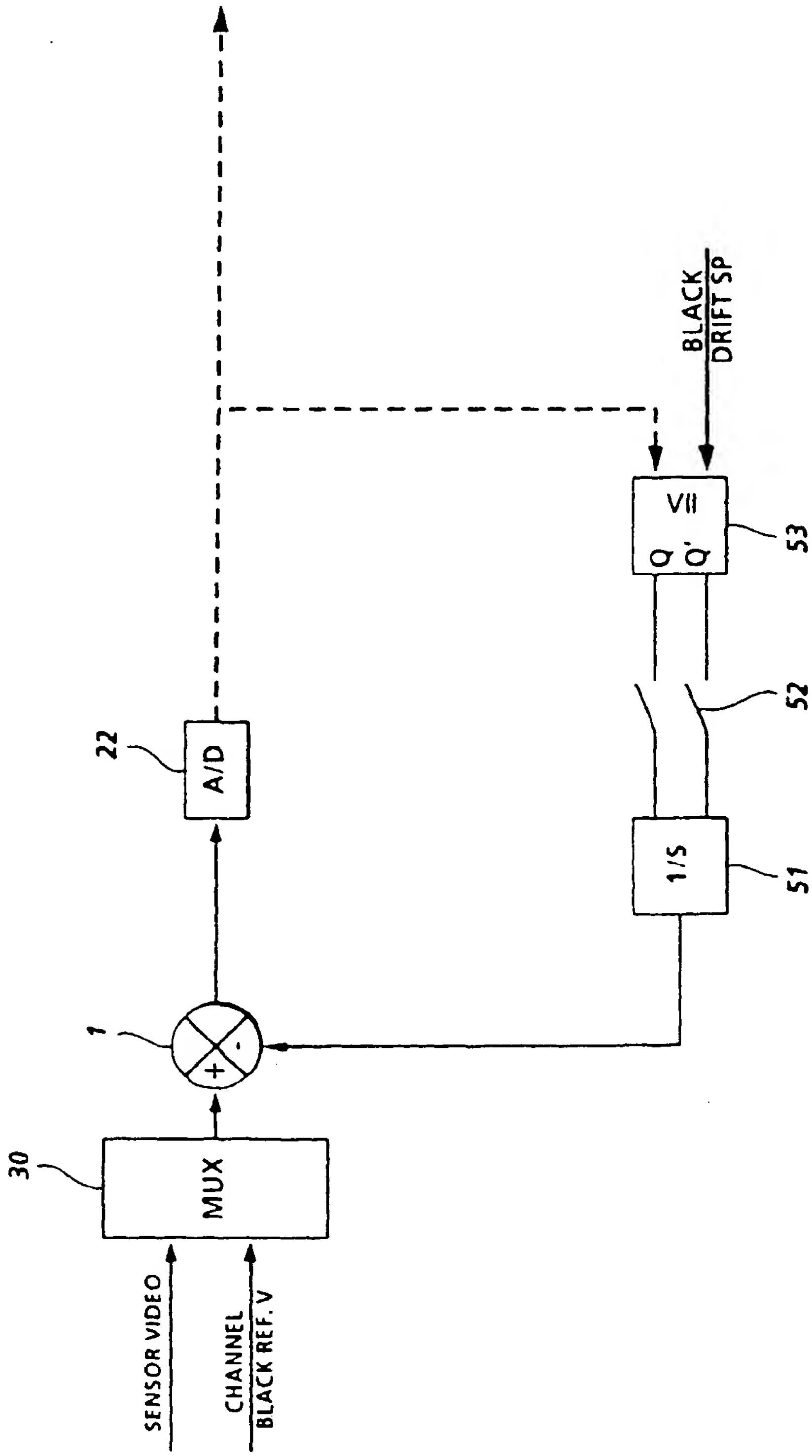
SENSOR VIDEO
CHANNEL BLACK REF. V
MUX
30
+
-
1
A/D
22
1/S
51
52
Q
Q'
VII
53
BLACK DRIFT SP

FIG. 5

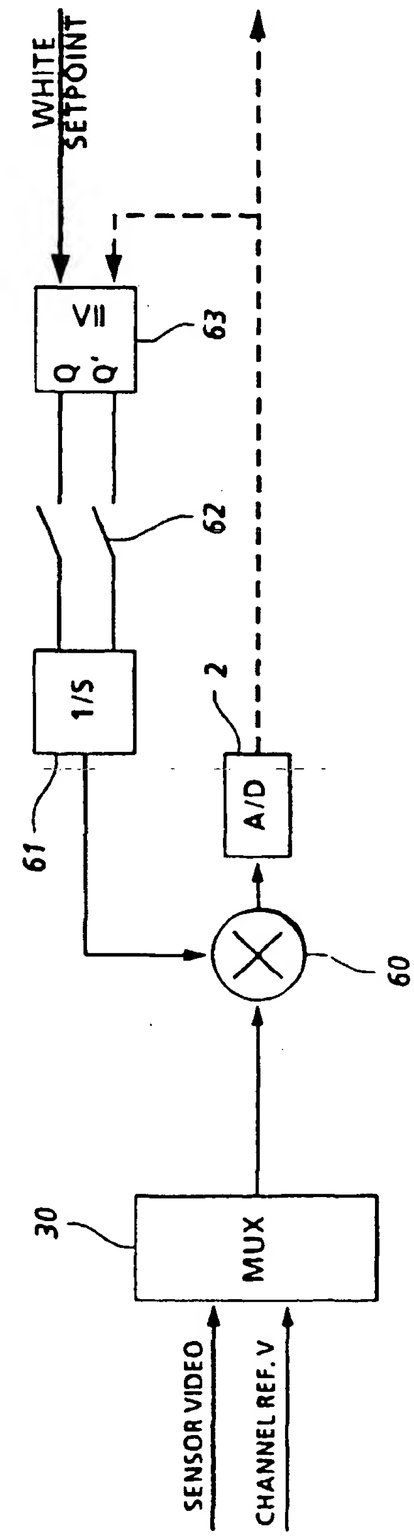
WHITE SETPOINT
VII
Q
Q'
63
62
1/S
2
A/D
61
60
30
MUX
SENSOR VIDEO
CHANNEL REF. V

FIG. 6

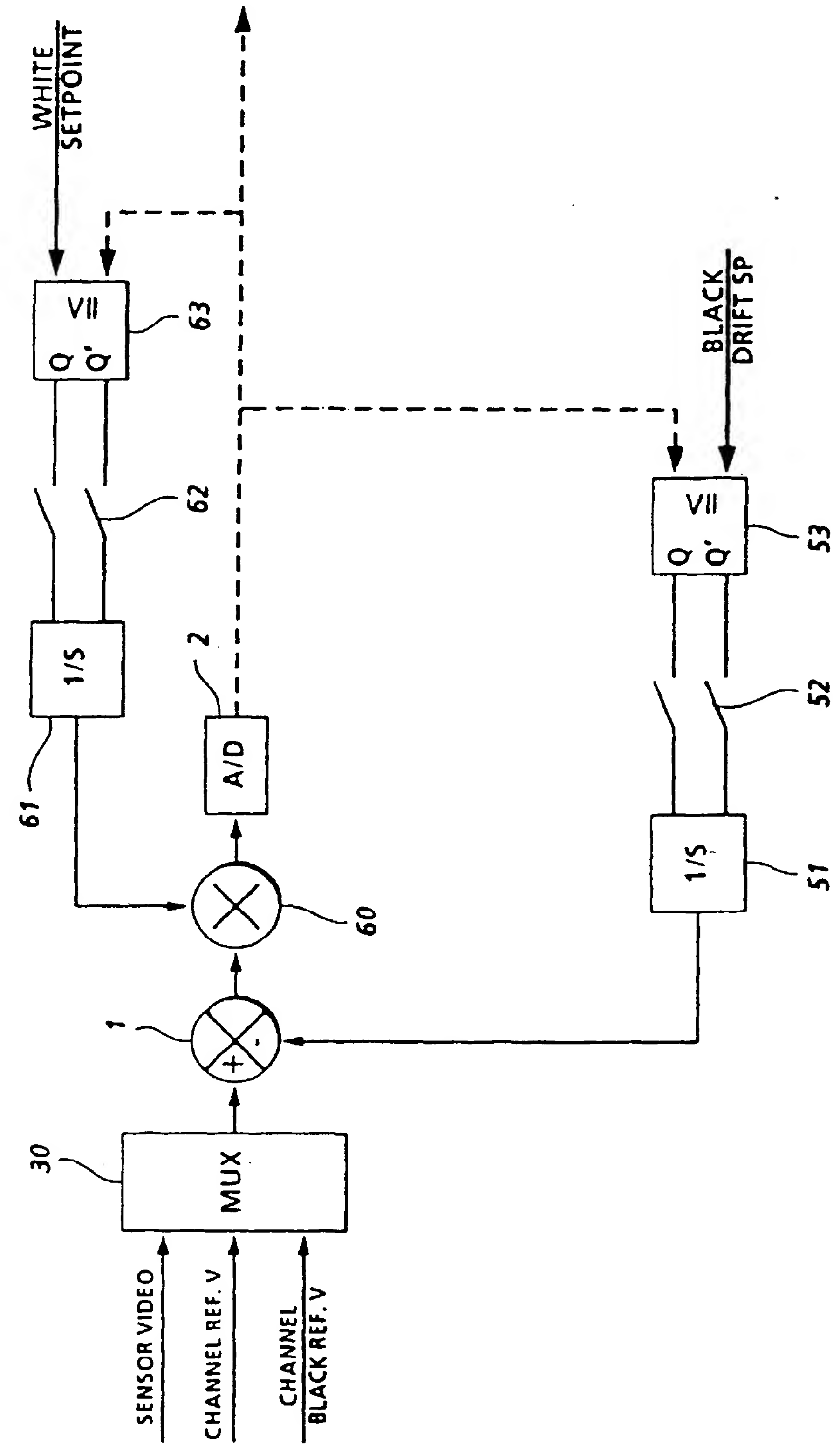
WHITE SETPOINT
VII
Q
Q'
63
62
1/S
61
2
A/D
60
1
+
-
30
MUX
SENSOR VIDEO
CHANNEL REF. V
CHANNEL BLACK REF. V
BLACK DRIFT SP
VII
Q
Q'
53
52
1/S
51

FIG. 1

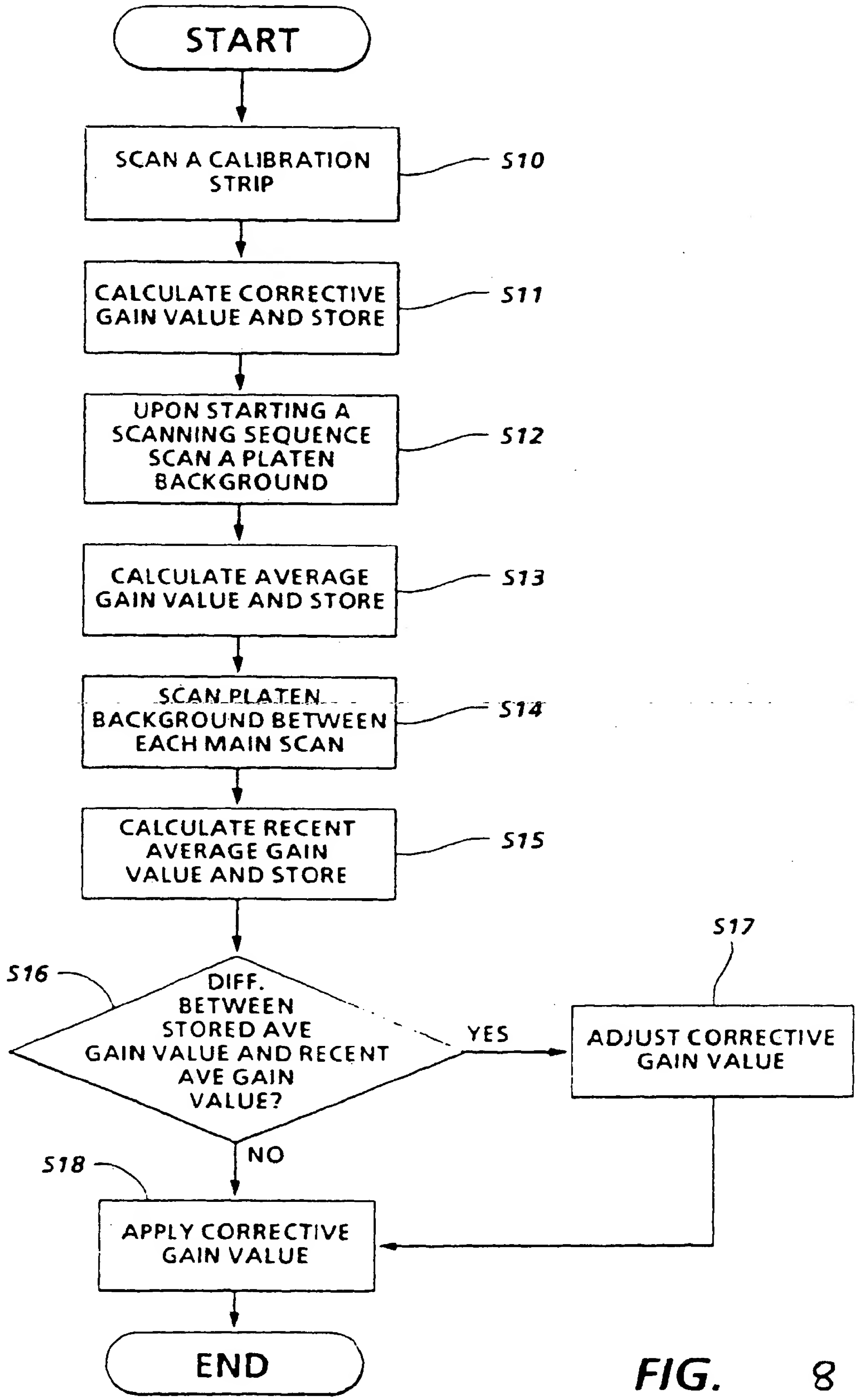
START
SCAN A CALIBRATION STRIP
S10
CALCULATE CORRECTIVE GAIN VALUE AND STORE
S11
UPON STARTING A SCANNING SEQUENCE SCAN A PLATEN BACKGROUND
S12
CALCULATE AVERAGE GAIN VALUE AND STORE
S13
SCAN PLATEN BACKGROUND BETWEEN EACH MAIN SCAN
S14
CALCULATE RECENT AVERAGE GAIN VALUE AND STORE
S15
S16
DIFF. BETWEEN STORED AVE GAIN VALUE AND RECENT AVE GAIN VALUE?
YES
S17
ADJUST CORRECTIVE GAIN VALUE
NO
S18
APPLY CORRECTIVE GAIN VALUE
END

FIG. 8

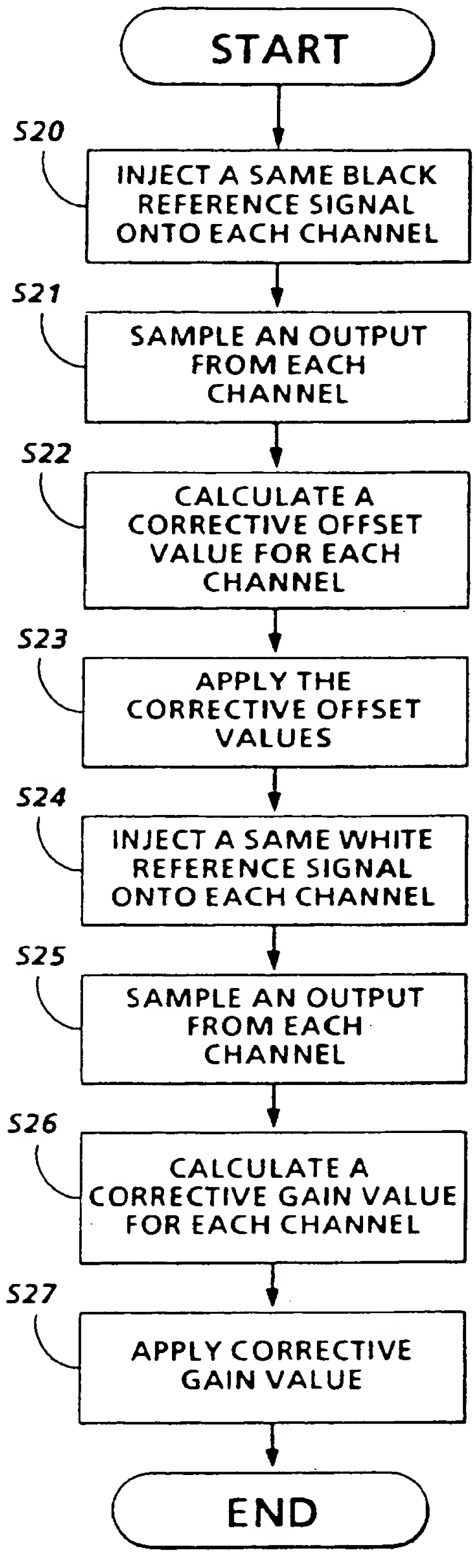
START
S20
INJECT A SAME BLACK REFERENCE SIGNAL ONTO EACH CHANNEL
S21
SAMPLE AN OUTPUT FROM EACH CHANNEL
S22
CALCULATE A CORRECTIVE OFFSET VALUE FOR EACH CHANNEL
S23
APPLY THE CORRECTIVE OFFSET VALUES
S24
INJECT A SAME WHITE REFERENCE SIGNAL ONTO EACH CHANNEL
S25
SAMPLE AN OUTPUT FROM EACH CHANNEL
S26
CALCULATE A CORRECTIVE GAIN VALUE FOR EACH CHANNEL
S27
APPLY CORRECTIVE GAIN VALUE
END

FIG. 9

(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 0 862 320 A3

(12) **EUROPEAN PATENT APPLICATION**

(88) Date of publication A3:
23.09.1998 Bulletin 1998/39

(43) Date of publication A2:
02.09.1998 Bulletin 1998/36

(21) Application number: **98108508.7**

(22) Date of filing: **01.07.1994**

(51) Int. Cl.⁶: **H04N 1/407**

(84) Designated Contracting States:
DE FR GB

(30) Priority: **01.07.1993 US 83583**

(62) Document number(s) of the earlier application(s) in accordance with Art. 76 EPC:
94304828.0 / 0 632 644

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(54) **An apparatus and method for correcting offset and gain drift present during communication of data**

(57) The present invention is directed to a system and method for compensating for offset and gain drift in a fast scan direction during an image forming process. To achieve compensation, the present invention samples a plurality of permanently darkened pixels upon powering up image sensors and circuitry therefor and during a sub-scanning process of an image and feeds this information into an offset value generating circuit. The offset generating circuit continually adjusts a pixel offset voltage according to a difference between sequential samples of the permanently darkened pixel, thereby compensating for fast scan offset drift. The present invention also samples a plurality of active pixels during a scanning of a calibration strip. From this scan, a gain corrective value is calculated. The present invention then samples active pixels during a scanning of a platen background. In response to this sampling, the gain corrective value is continually adjusted according to a difference between sequential samples of the platen background, thereby compensating for fast scan gain drift. The present invention can also compensate and balance transfer functions for a plurality of communication channels in a multi-channel system by using the same target values and same reference signals for each channel.

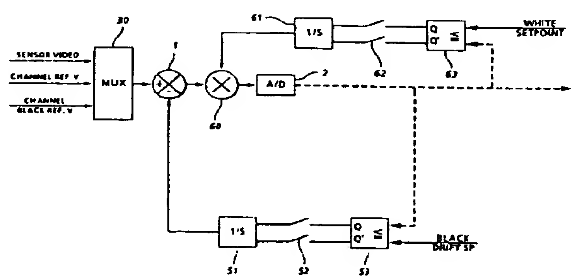

FIG. 7

EP 0 862 320 A3

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EUROPEAN SEARCH REPORT

Application Number
EP 98 10 8508

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
X	US 3 952 144 A (KOLKER CARL RAYMOND) 20 April 1976 * abstract; figures 1,2 * * column 2, line 44 - line 55 * * column 6, line 29 - line 57 * * column 11, line 17 - column 13, line 31 *	1,2	H04N1/407
A	US 3 619 493 A (KRALLINGER ROBERT E ET AL) 9 November 1971 * abstract; figure 1 *	1	
A	EP 0 402 295 A (IBM) 12 December 1990 * abstract; figure 1 * * column 1, line 23 - line 53 * * column 3, line 39 - column 4, line 21 *	1	
A	US 4 682 360 A (FREDERIKSEN JEFFREY E) 21 July 1987 * figure 2 * * column 5, line 45 - line 64 *	1,2	TECHNICAL FIELDS SEARCHED (Int.Cl.6)
A	GB 2 118 807 A (CANON KK) 2 November 1983		H04N H04B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
BERLIN	27 July 1998	Kassow, H

CATEGORY OF CITED DOCUMENTS

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